



## ***The NASA Electronic Parts and Packaging (NEPP) Program***

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**Space Parts Working Group Meeting  
April 26, 2000**



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# Outline

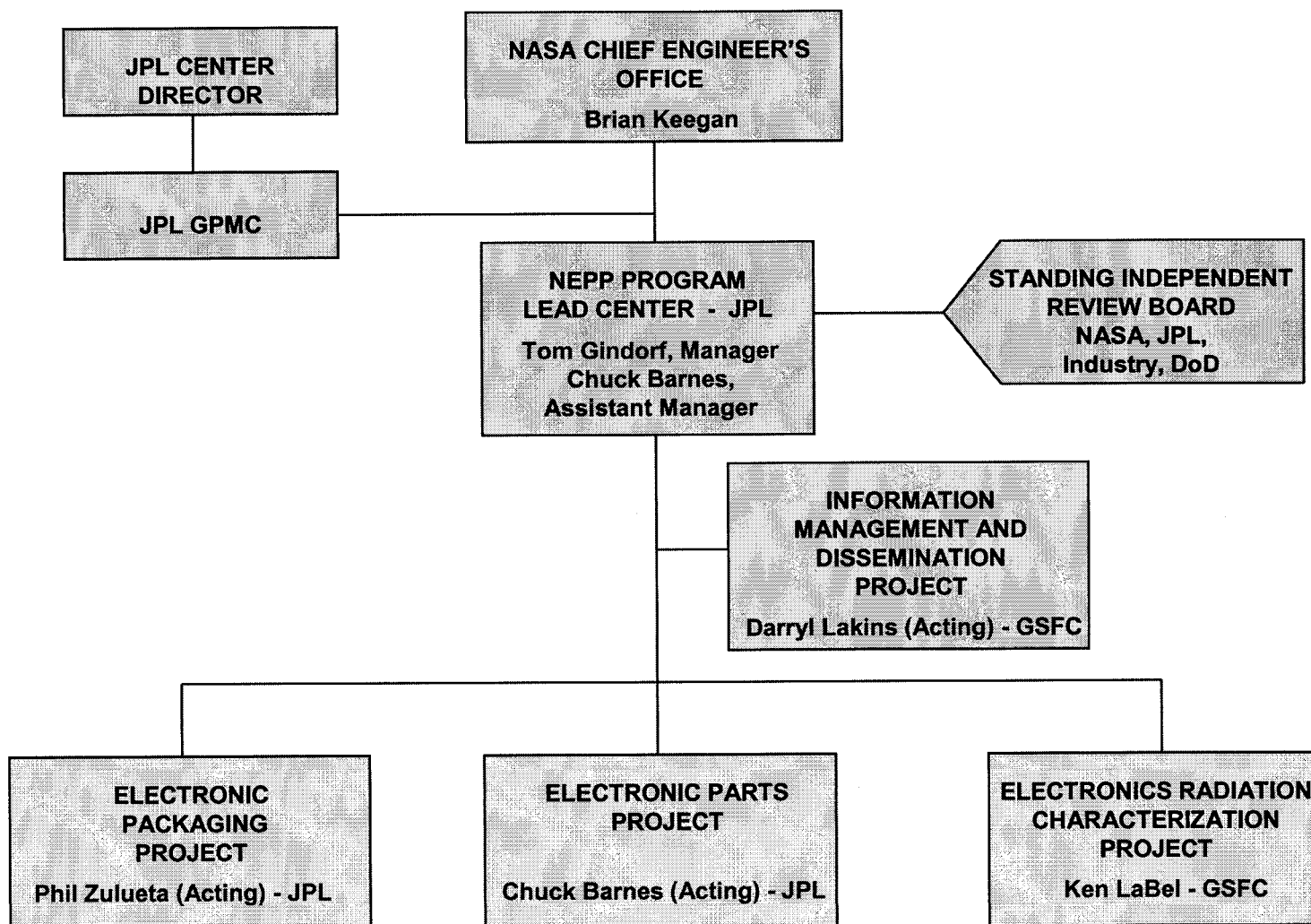


- **Program Overview**
  - ◆ Organization
  - ◆ Objectives and policies
  - ◆ Value and relevance to NASA
- **Summary of Projects**
  - ◆ Electronic Packaging Project
  - ◆ Electronics Radiation Characterization Project
  - ◆ Information Management and Dissemination Project
- **Conclusions**
- **Contacts**



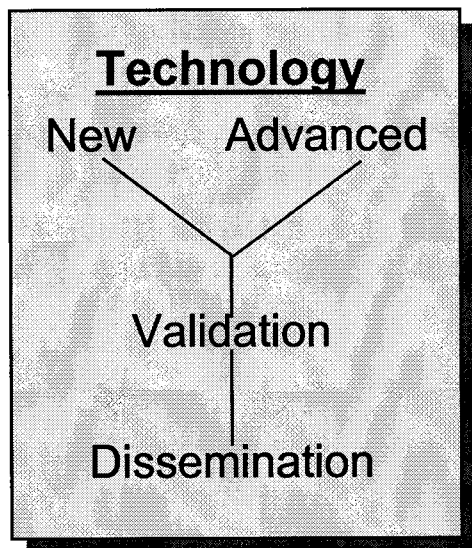


# The NEPP Program Structure





# NASA Electronic Parts and Packaging Program



## ● **Program Objectives**

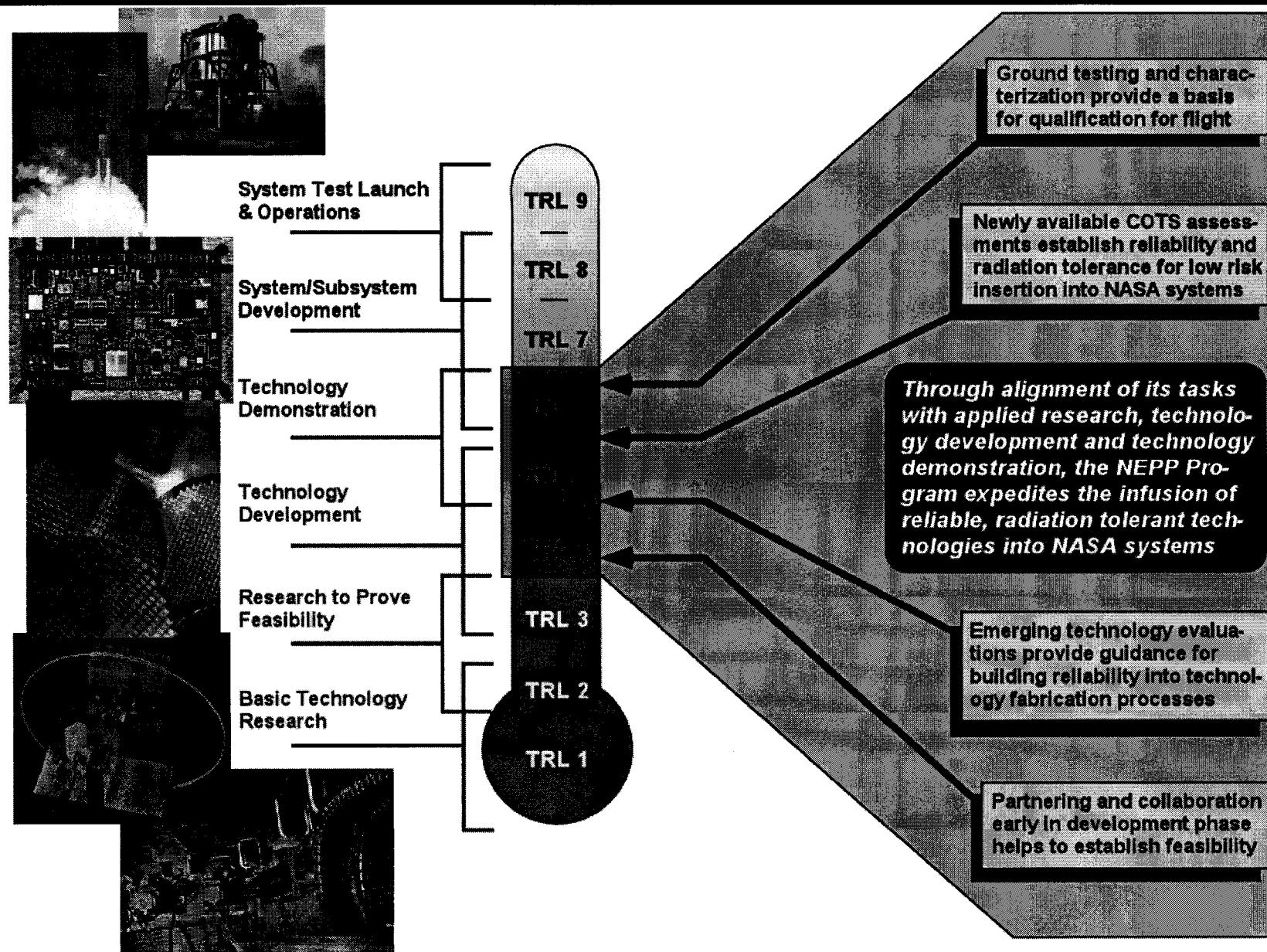
- ◆ Assess the reliability of newly available electronic parts and packaging technology
- ◆ Evaluate advanced parts and packaging technology to expedite its readiness for infusion
- ◆ Develop new methods and processes for parts and packaging evaluation, selection, and qualification of new technology and existing electronics.
- ◆ Disseminate quality assurance, reliability, validation, tools and availability information to the NASA community

## ● **Policy Statements**

- ◆ The NASA Electronic Parts and Packaging Program will be coupled to existing or future NASA Project needs
- ◆ Tasks must have Project's endorsement and co-funding will be given priority
- ◆ Leveraging with industry, academia and government agencies, to multiply the effectiveness of the programs, will be actively pursued
- ◆ Program priorities will be assessed quarterly to ensure that tasks are meeting Project needs. Where applicable, tasks will be redirected, modified or canceled to support changing priorities

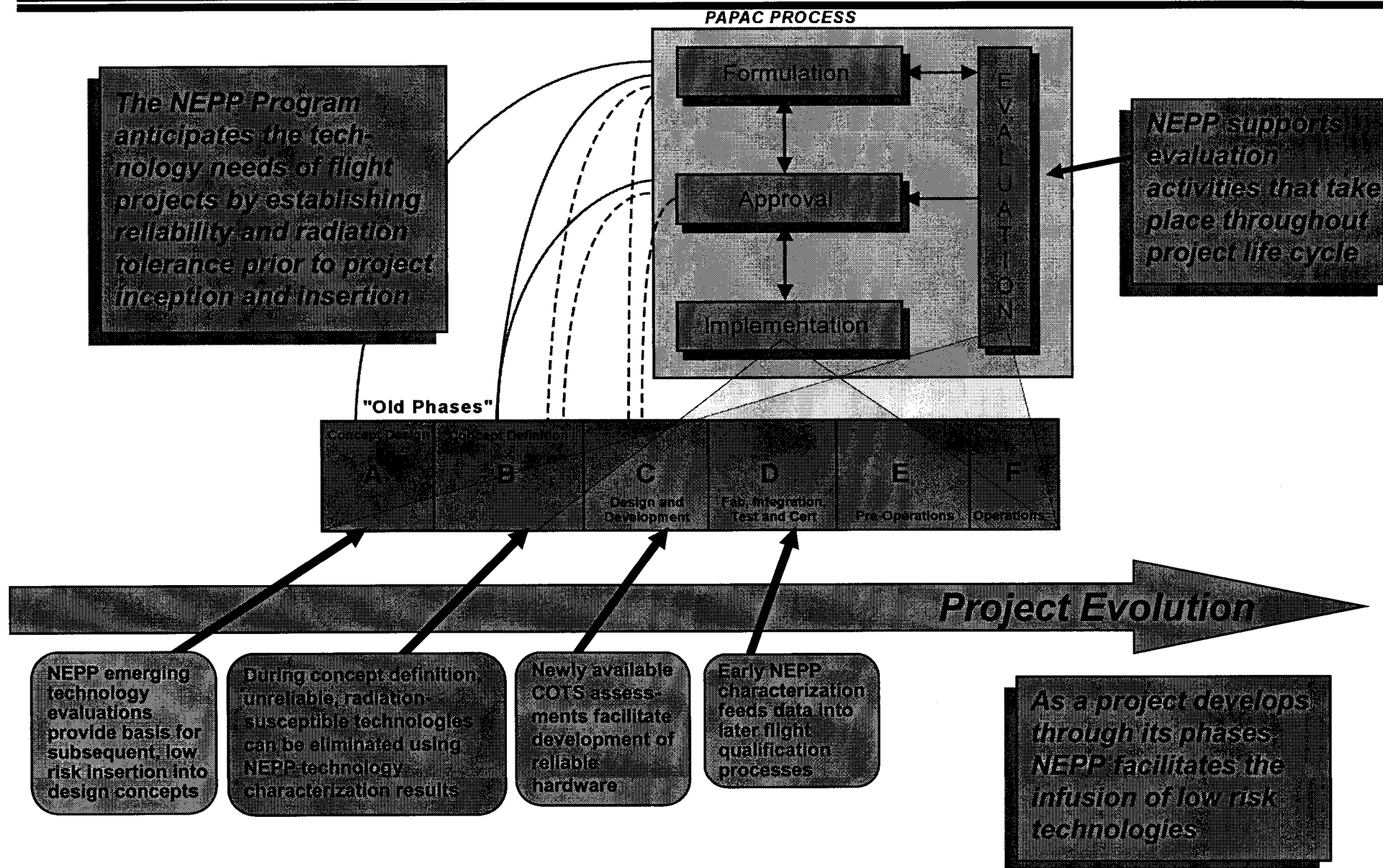


## NEPP and TRLs: A Path to Rapid Technology Infusion

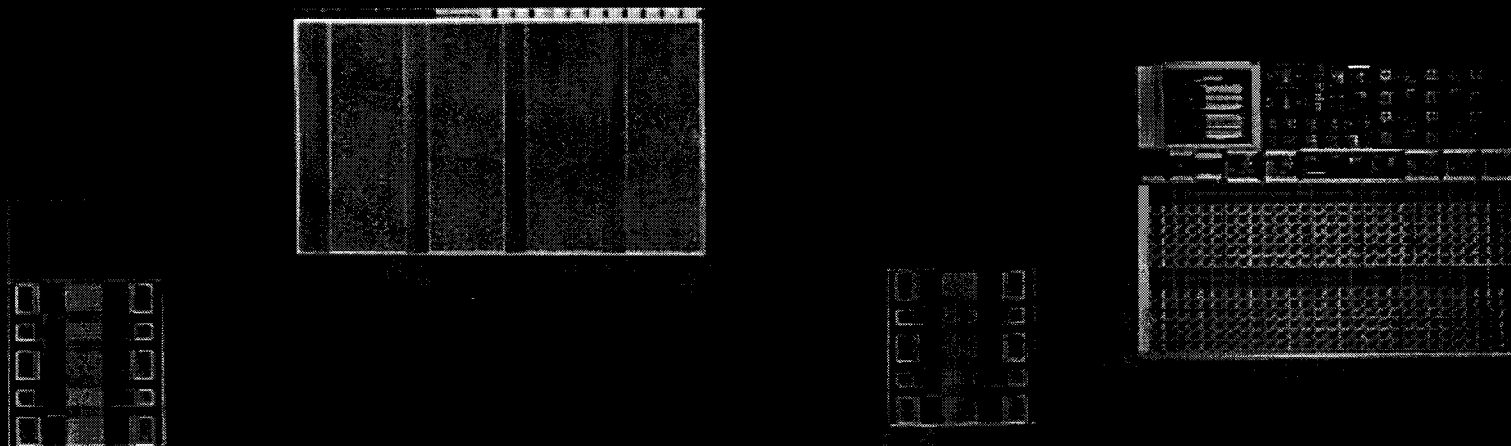




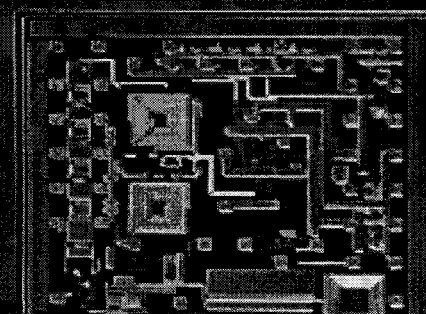
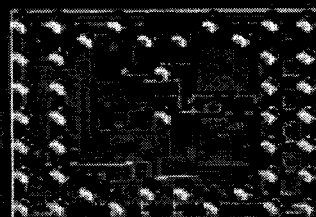
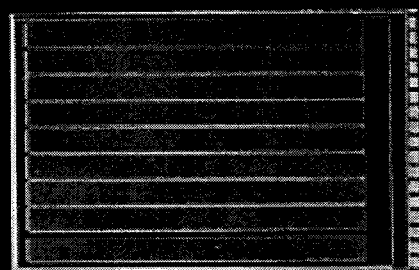
## Alignment of NEPP Program with NASA Flight Projects







# ***The NEPP Electronic Packaging Project (EPAC)***



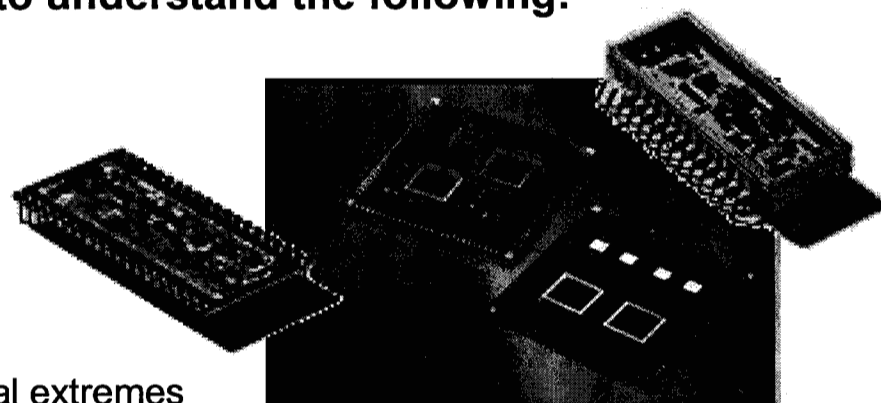




## Electronic Packaging Project Focus

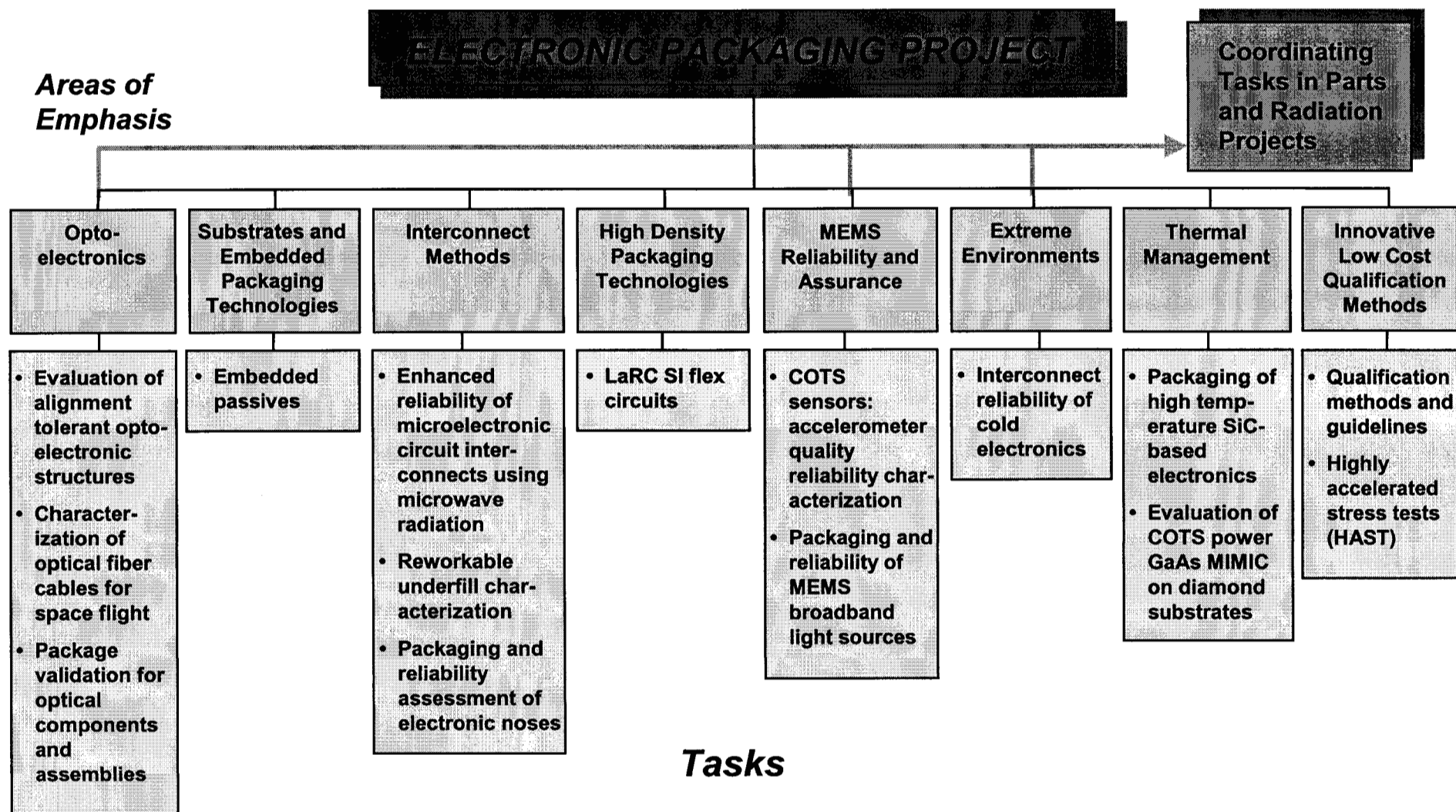


- **NASA's Electronic Packaging Project is focused on assessing new interconnect and electronics packaging technologies to understand the following:**
  - dominant failure modes
  - material characteristics
  - manufacturing processes
  - preventative measures
  - reliability of the interconnects in environmental extremes
  - influence of compound variability on quality and reliability
  - quality assurance standards for highly reliable interconnects
- **Understanding these issues and phenomena will allow flight projects to insert advanced packaging technologies into their systems in a manner that minimizes risk to the mission**





# FY01 Electronic Packaging Project Tasks





# FY99, FY00 Activities

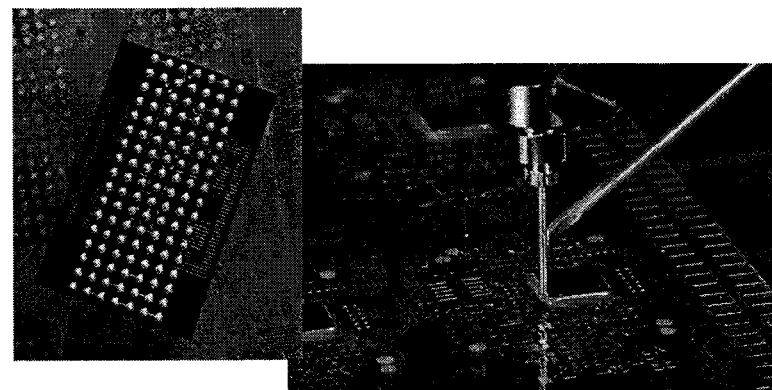
## Device Interconnection Technologies



*Materials, processes and technologies of device interconnections to rigid and non-rigid substrates and boards.*

### Objectives

- Assess the reliability of new and advanced technologies for NASA electronics applications
- Evaluate and characterize new packaging materials for device interconnections and the reinforcement of device attachments
- Develop quality assurance guidelines for device interconnection technologies in aeronautic and space applications
- Develop packaging in-process tests and qualification methods for device interconnections



### Benefits

- In-process tests and qualification methods allow faster infusion into NASA programs
- Quality assurance guidelines facilitates efficient infusion into NASA mission requirements
- Enhanced reliable interconnections of electronic assemblies

### Tasks (JPL, GSFC, LaRC, MSFC)

- Robust Manufacturing Processes for CSPs
- Reworkable Underfill Characterization
- Processes for Utilizing Laser Machined Metallized Polyimide for Electronic Circuit Applications

### Major Accomplishments

- Released joint NASA/IPC/ITRI "Ball Grid Array Packaging Guidelines" for use by NASA, its contractors, and aerospace companies.
- Demonstrated quality assurance controls and reliability limitations of surface mount assemblies (SMA).
- Developed BGA Training Module for the NASA/JPL Training Center.
- Led a consortium of 24 industry team members for the first extensive study of processes and analyses for COTS miniature CSPs.
- Completed environmental validation tests for baseline DCA and passivation approach.



## FY99, FY00 Activities Attachment Materials Technology



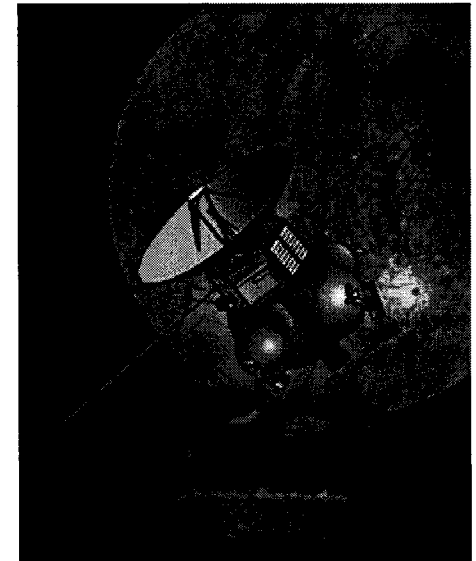
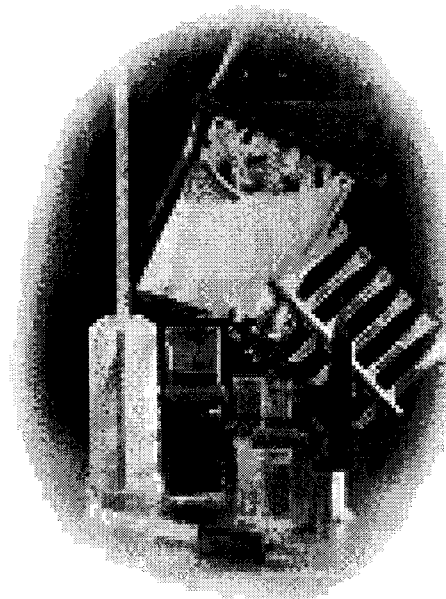
*Adhesive/bonding materials, techniques and procedures related to the assembly of microelectronic, photonic and electronic packages and circuits.*

### Task

- Investigate reliability of advanced bonding techniques and adhesives for space applications.

### Benefits

- New bonding techniques and adhesives allow the miniaturization of space flight hardware.
- Allows successful microelectronic operation in harsh environmental conditions.



### Major Accomplishments

- Investigated adhesive bonding issues and wire bond reliability issues of microelectronic circuits for cofunded Mars Rovers, MLS and MIRO programs.



COSMIC  
RAY

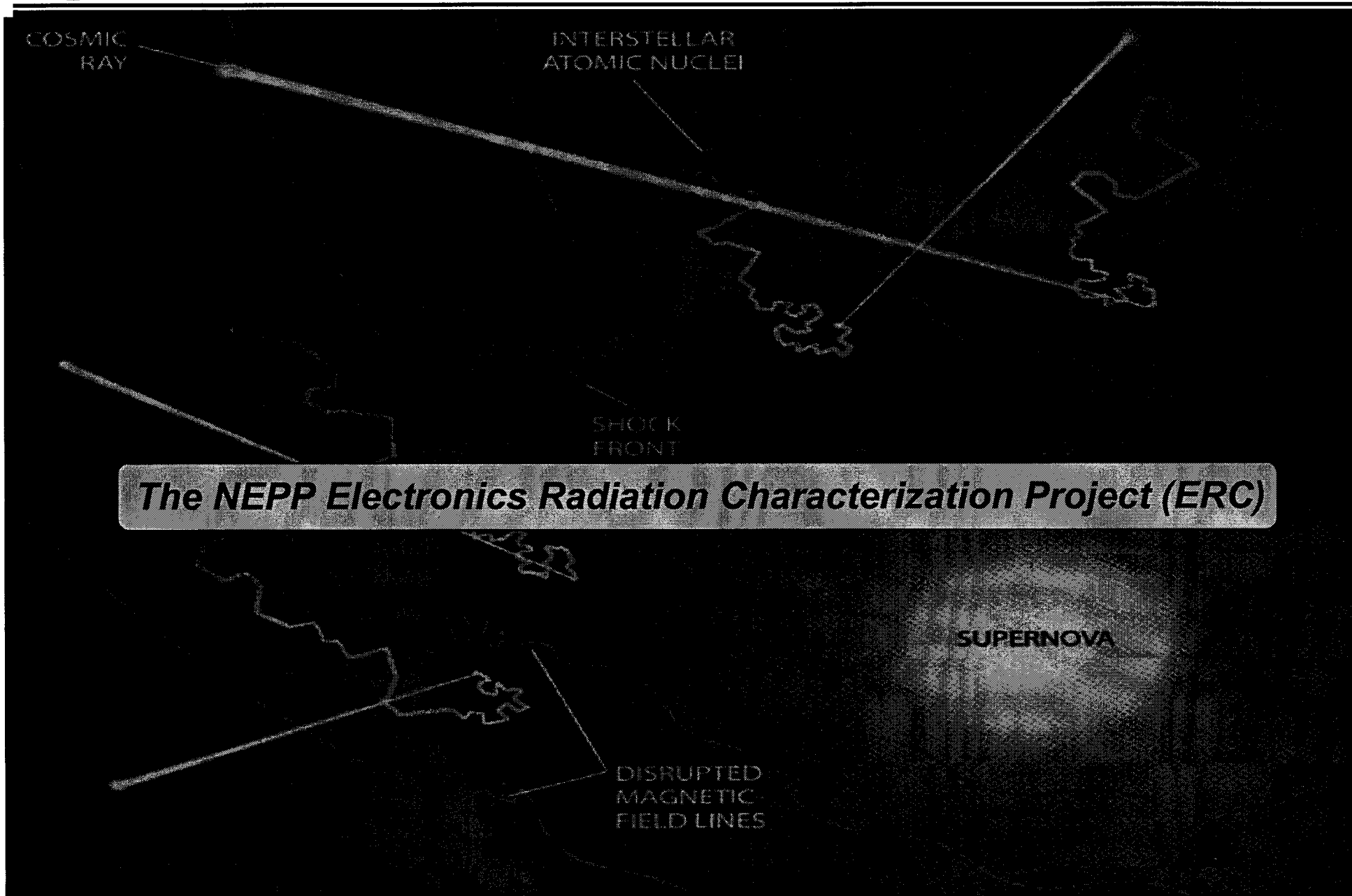
INTERSTELLAR  
ATOMIC NUCLEI

SHOCK  
FRONT

## ***The NEPP Electronics Radiation Characterization Project (ERC)***

SUPERNOVA

DISRUPTED  
MAGNETIC  
FIELD LINES

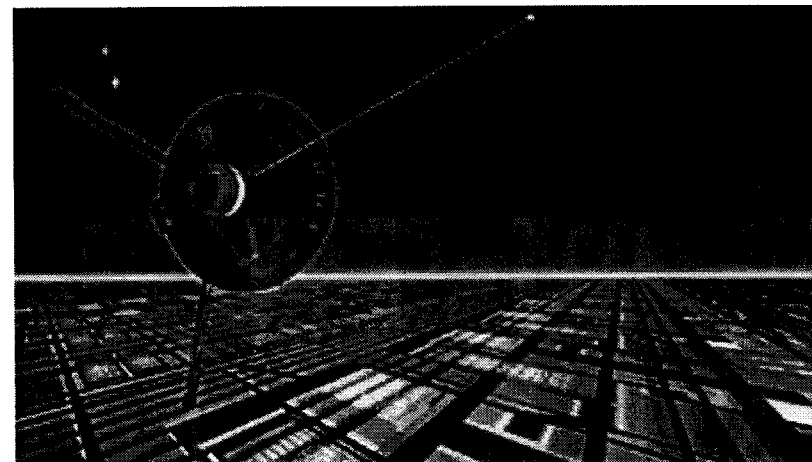




## Electronics Radiation Characterization (ERC) Project Focus



**The overall goal of the ERC Project is to enable and accelerate the infusion of newly available COTS and emerging technology microelectronics and photonics into NASA flight systems through radiation characterization and evaluation which establishes radiation hardness assurance (RHA) and minimizes risk**

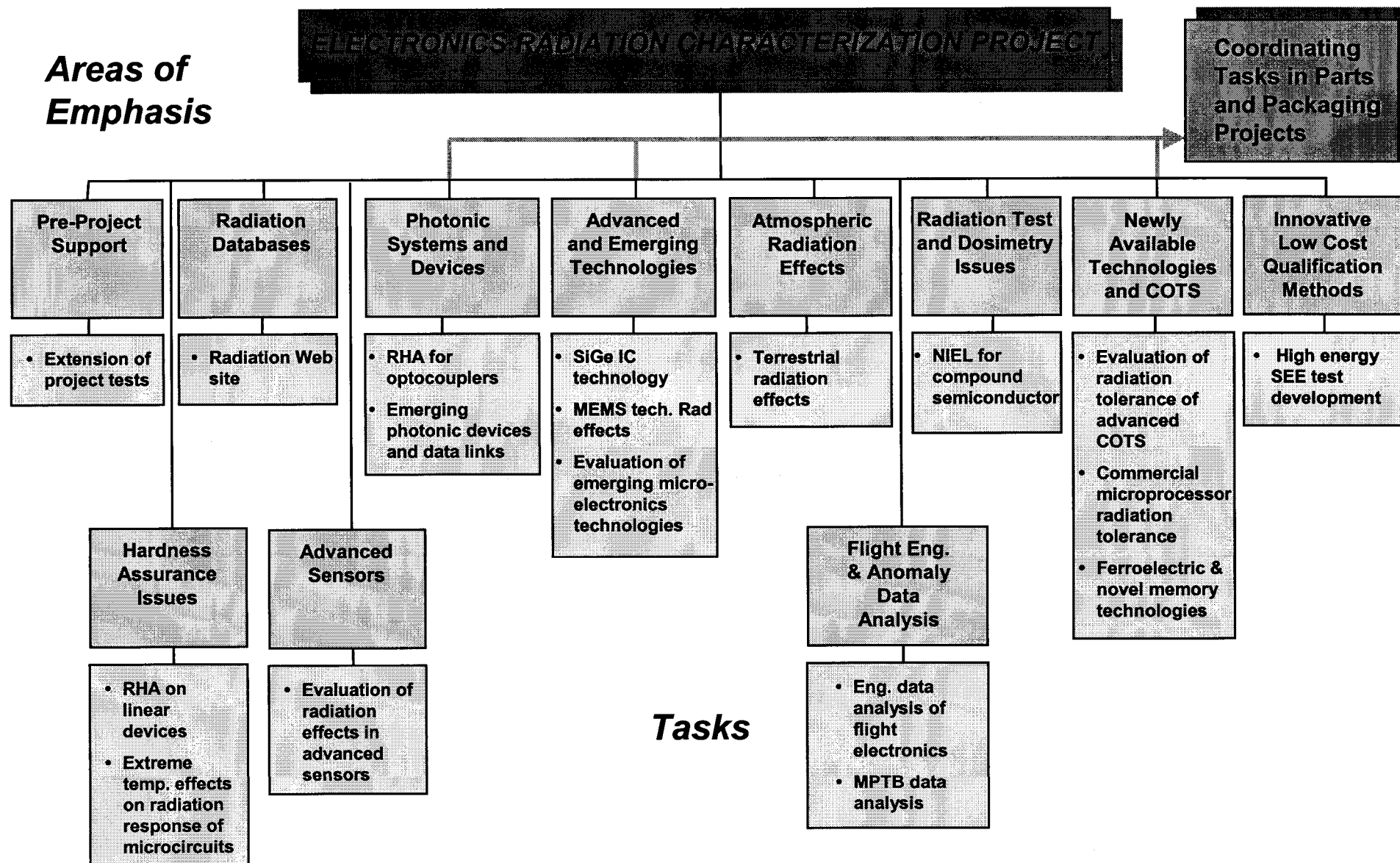




# FY01 Electronics Radiation Characterization (ERC) Project Tasks



## Areas of Emphasis







## FY99, FY00 Activities New Technology (COTS) Microelectronics

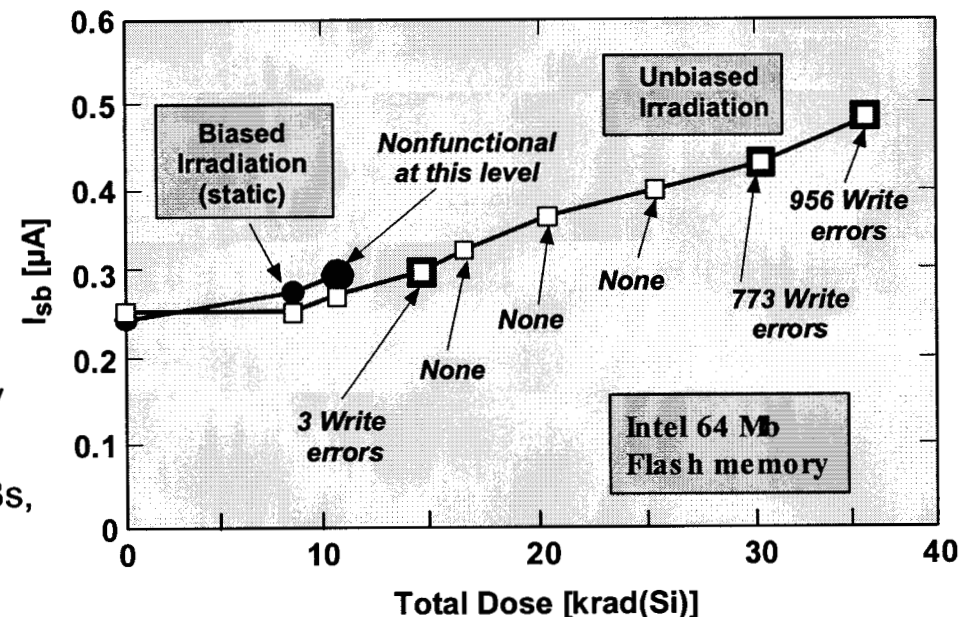


### Task

- Radiation Testing of New Technology (COTS) Microelectronic Devices

### Accomplishments

- Testing of programmable devices with new architectures
- Tests of multi-level flash memories and detection of bit errors between states
- Evaluation of gate rupture in test structures of highly scaled CMOS processes
- Comparison of commercial SRAM SEE sensitivity
- Radiation evaluations of COTS devices such as microprocessors, DC-DC Converters, COTS PCBs, ADC/DACs, and linears



### Benefits

- Determination of failure modes and mechanisms for new technologies
- Accelerated infusion of these devices in space
  - ◆ *Increased availability of COTS device data for designers*
    - Decouples device selection by designers from radiation characterization needs by the flight project



## FY99, FY00 Activities Flight Engineering and Anomaly Data Analysis



### Task

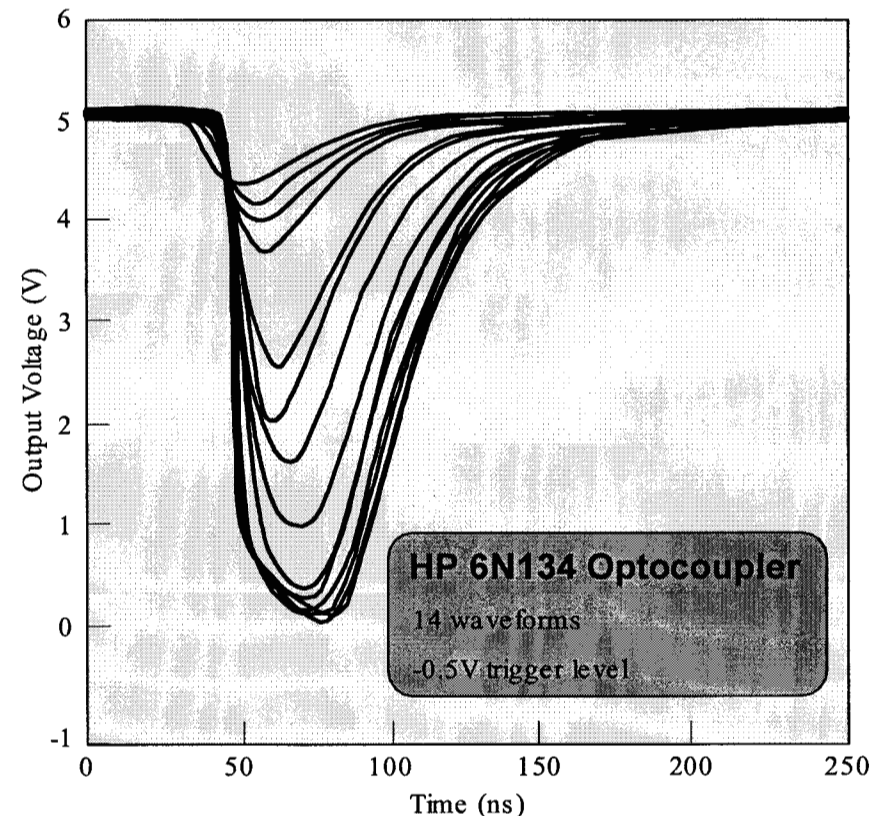
- Evaluate Flight Performance and In-Flight Anomalies

### Accomplishments

- Evaluated transients in Hubble space telescope (HST) upgrade, and attributed cause to proton upset effects in optocouplers
- Compared error rate in HST solid-state recorder with ground test data and determined that low-probability effects were highly significant because of the large number of memories used in the application
- Analyzed effects of single-event transients on Cassini spacecraft
- Evaluated flight data from MPTB (fiber optic bus experiment, dual-port SRAMs), SeaStar, XTE, TRMM, SAMPEX, and others

### Benefits

- Established cause of flight anomalies
  - ◆ *Provided "lessons learned" for new projects*





## FY99, FY00 Activities Pre-Project Support



### Task

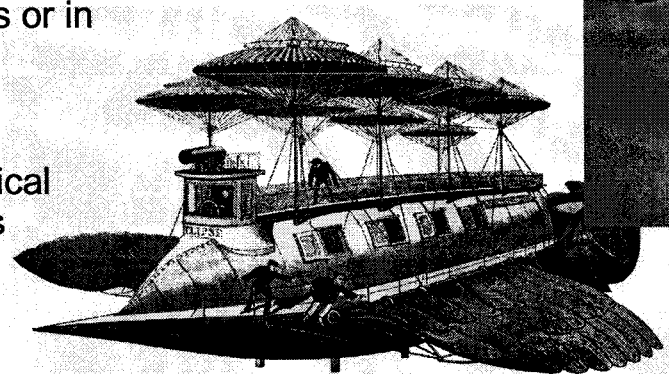
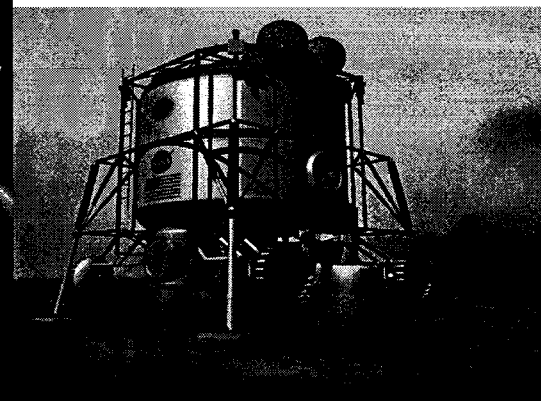
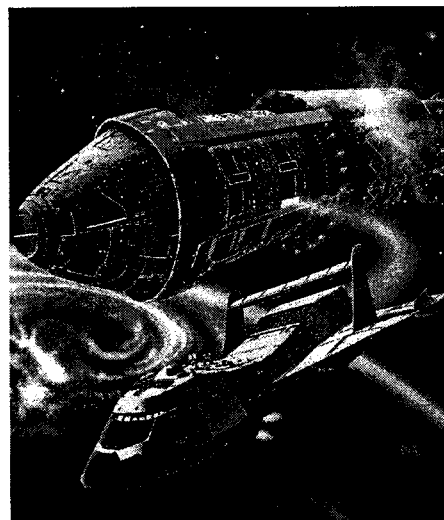
- Provide Pre-Project Support for Analysis and Testing for Small NASA Projects and Instruments

### Accomplishments

- Radiation testing of critical components for MUSES program
- Analysis of cosmic ray effects on Martian surface
- Radiation testing of analog-to-digital converters for NASA Langley RC
- Evaluated parts lists for multiple NASA projects at all Centers (co-funded by projects)
- Provided initial radiation requirements and specifications for flight projects or in aiding proposal development

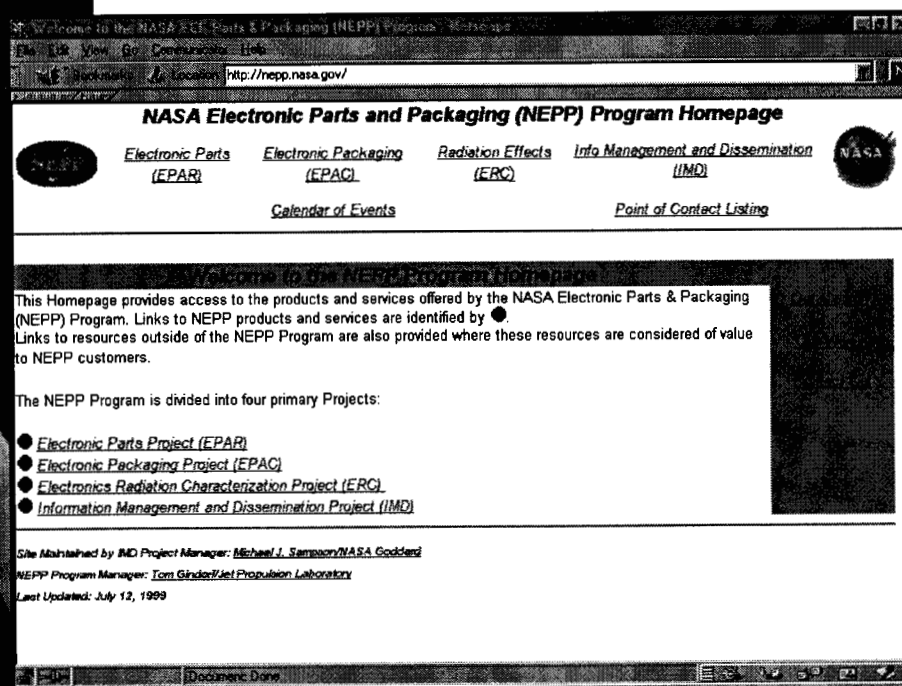
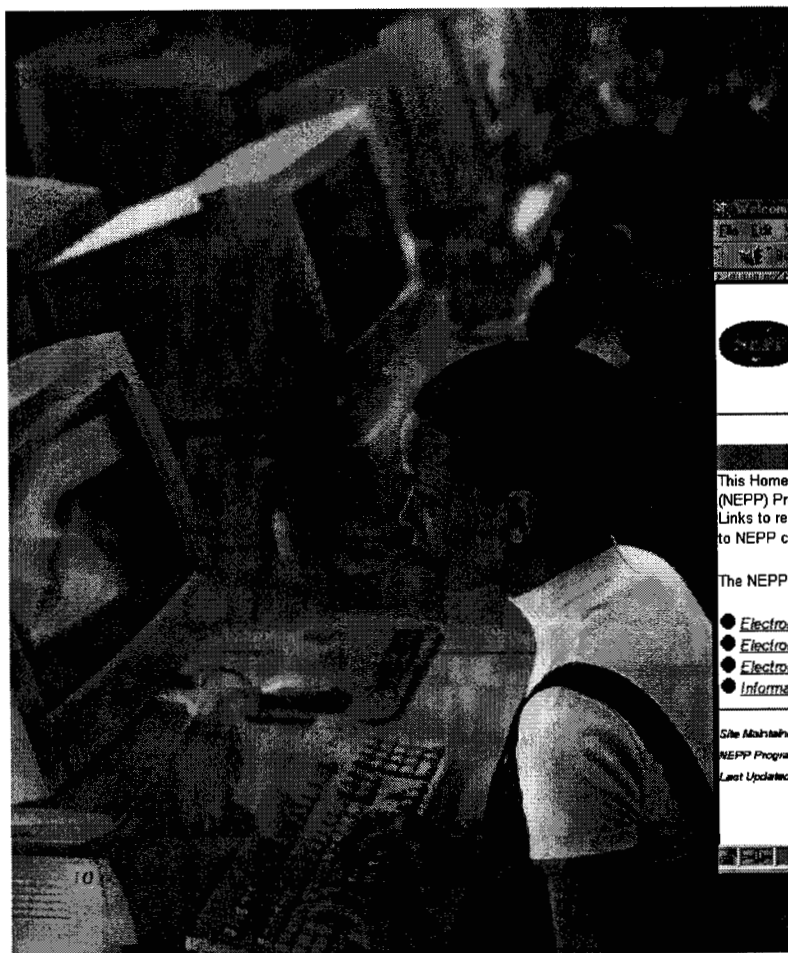
### Benefits

- Early in project cycle, provides critical information to small projects that is essential for design and planning decisions



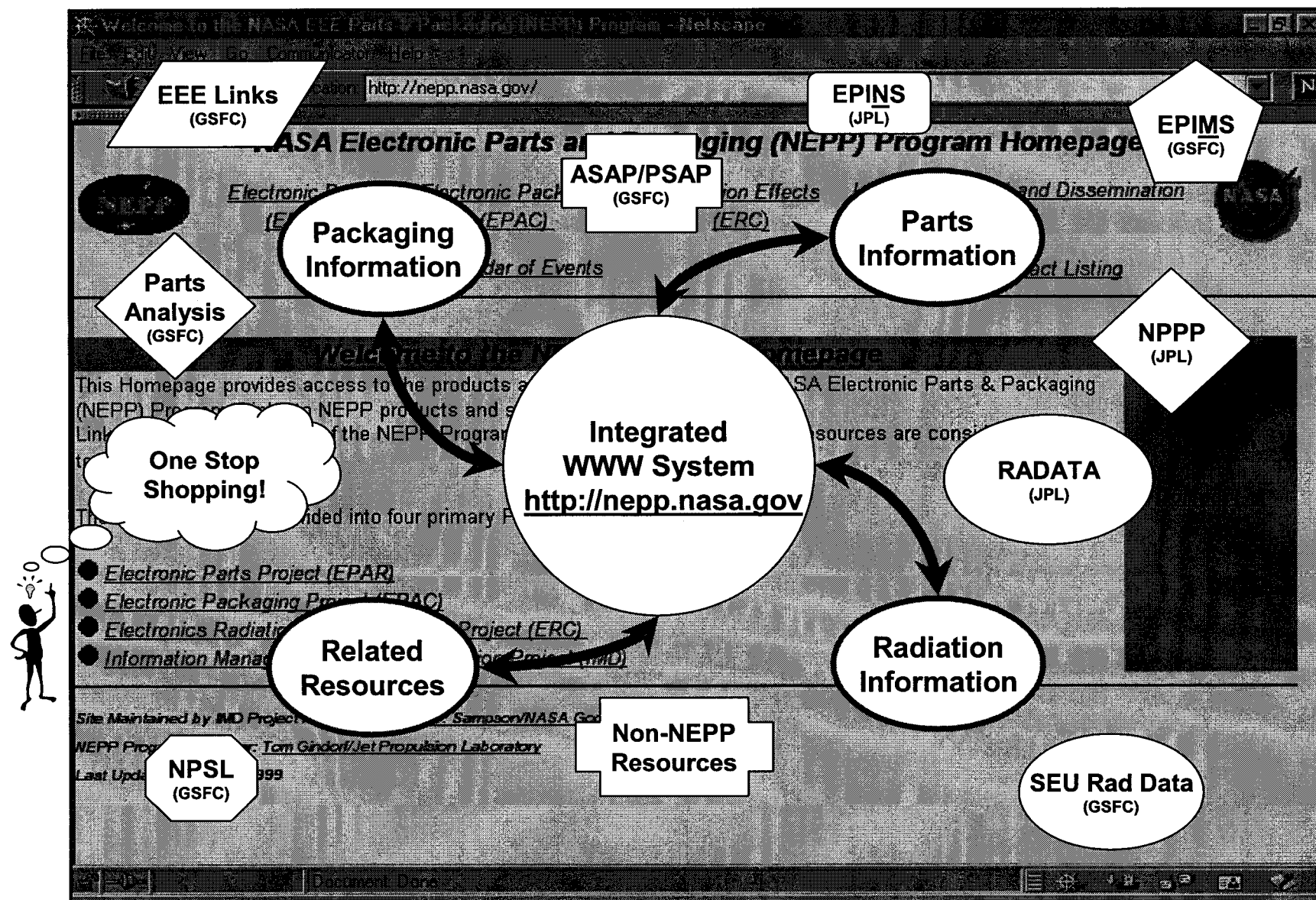


## The NEPP Information Management and Dissemination (IMD) Project





# Information Management & Dissemination Project Activities





## Conclusions



- The primary objective of the NEPP Program is to facilitate the infusion of new and advanced technologies into NASA systems in a manner that enables new levels of performance and minimizes risk
- It is important that the NEPP Program maintain close alignment with NASA Projects and Program Offices so that needed technologies can be anticipated, characterized and evaluated
- The NEPP Program must also build awareness, partnerships and collaborations with the space community outside of NASA in order to maintain a highly effective Program

